

Not less important than the natural advantages of the Station in climate and vegetation is its accessibility, and the fact that it is located in an English-speaking country with a stable government and reliable sanitary control. For the past ten years it has been a station of the New York Botanical Garden, but it is now to be maintained under the auspices of the British Association for the Advancement of Science with the cooperation of the Jamaican government.—
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NOTES FOR STUDENTS

Cultures of the Uredineae.—In the review covering the cultural work with the Uredineae for 1912,⁴ the following results of TREBOUX and of LONG should have been included. TREBOUX⁵ in two papers from Nowotscherkask, reports the following cultures. Teleutospores of *Uromyces Festucae* Syd. from *Festuca ovina* L. produced aecidia on *Ranunculus illyricus* L. (The reverse culture has previously been reported.)⁶ Aecidiospores from *Allium decipiens* Fisch., *A. moschatum* L., *A. rotundum* L., and *A. sphaerocephalum* L. produced uredospores and teleutospores (*Puccinia permixta* Syd.) on *Diplachne serotina* Lk. The reverse infection on 3 of these and 13 other species of *Allium* was successful also. Teleutospores of *Puccinia stipina* Tranzsch. from *Stipa capillata* L. infected 5 native species of *Salvia* and 15 others grown from seed, and also *Origanum vulgare* L., *Lamium amplexicaule* L., *Glechoma hederacea* L., *Lallemantia iberica* F. et M., *Leonurus cardiaca* L., and *Stachys recta* L. This rust shows very little selection among the Labiatae. *Puccinia littoralis* Rostr. from *Juncus Gerardi* Lois. produced aecidia on *Cichorium Intybus* L. (the reverse culture has been previously reported). Aecidiospores of *Puccinia Polygoni-amphibii* Pers. from *Geranium collinum* Steph. infected *Polygonum amphibium* L. but not *P. lapathifolium* L. The reverse infection was successful on *Geranium collinum* L., *G. pratense* L., *G. divaricatum* Ehrh., *G. columbinum* L., and *G. rotundifolium* L. Aecidiospores of the autoecious form *P. ambigua* Alb. et Schw. on *Galium aparine* L. produced successive generations of aecidia when sown on that host. Aecidiospores of *Puccinia Agropyri* Ell. et Ev. from *Clematis pseudo-flammula* Schmalh. infected *Agropyrum repens* P.B. The uredospores from this culture infected *Agropyrum cristatum* Bess. and *A. prostratum* Eichw. Aecidiospores of *Puccinia bromina* Erikss. from *Lithospermum arvense* L. infected *Bromus tectorum* L. and *B. squarrosus* L. Similarly aecidiospores from *Myosotis silvatica* Hoffm. infected *B. tectorum*. The two aecidia belong to the same rust. Aecidiospores and uredospores of *Uromyces Limonii* (DC.) from *Statice latifolia* Sm. infected *Statice Gmelini* Willd. also. Aecidiospores of an unnamed species of *Puccinia* from *Centaurea trichocephala*

⁴ BOT. GAZ. 56:233-239. 1913.

⁵ TREBOUX, O., Infektionsversuche mit parasitischen Pilzen II. Ann. Mycol. 10:303-306. 1912; and *idem* III. *Ibid.* 557-563. 1912.

⁶ Rev. BOT. GAZ. 56:239. 1913.

M.B. produced uredospores and teleutospores on *Carex stenophylla* Wahlenb. Aecidiospores from *Euphorbia virgata* W.K. infected *Caragana arborescens* L., *Trifolium agrarium* L., and *Lotus corniculatus* L., but none of the species usually inhabited by *U. Genistae-tinctoriae* Pers. This result seems to indicate that the species of *Uromyces* on *Caragana* is a biological form distinct from *U. Genistae-tinctoriae*. With aecidiospores from the same host from another locality, *Medicago minima* Bart., *M. murex* Willd., and *Trifolium arvense* L. were infected. This form proved to be *Uromyces striatus* Schroeter. A third form with its aecidia likewise on *Euphorbia virgata* produced uredospores and teleutospores (*Uromyces Astragali* Opiz.) on *Astragalus criticus* Lam. and *A. sanguinolentus* M.B. Aecidiospores of *Uromyces caryophyllinus* (Schrank) Wint. from *Euphorbia Gerardiana* Jacq. infected *Dianthus arenarius* L., *D. campestris* M.B., *D. capitatus* DC., *D. caryophyllus*, and *D. pseudomeria* M.B. Aecidiospores from other plants of *Euphorbia Gerardiana* produced an abundance of uredospores and teleutospores of *Uromyces Schroeteri* De Toni on *Silene otites* Sm. Sowings of aecidiospores (*Puccinia coronifera* Kleb.) from *Rhamnus cathartica* L. and reverse cultures and cross-sowing of the aecidiospores thus derived seem to show that the specialization of forms in this species of crown rust is not so well marked as former experiments appeared to indicate.

LONG'S⁷ experiments dealt with three species of rusts on members of the genus *Andropogon*. He reports the following successful cultures. Teleutospores of the type of *Puccinia Andropogonis* Schw. from *Andropogon furcatus* Muhl. collected in Texas produced aecidia on *Oxalis corniculata* L. Teleutospores of *Puccinia Ellisiana* Thüm. from *Andropogon virginicus* L. collected in Virginia produced aecidia on *Viola fimbriatula* Sw., *V. hirsutula* Brainard, and *V. papilionacea* Pursh. *Viola sagittata* L., which was not infected, had been successfully infected in a former experiment. Aecidiospores from *V. sagittata* and *V. papilionacea* reinfected *Andropogon virginicus*. In 1910 the author had sent material of this same type and from the same locality to ARTHUR, who made successful sowings of teleutospores on *Penstemon*. These two results seem to indicate that two forms of *Puccinia* occur on *Andropogon virginicus*. Finally, teleutospores of *Uromyces Andropogonis* Tracy from *Andropogon virginicus* L. collected in Virginia infected *Viola primulifolia* L. and *V. cucullata* Ait. but none of the other violets. Aecidiospores from *V. primulifolia* reinfected *Andropogon virginicus*. In conclusion, the author points out the close similarity between *Puccinia Ellisiana* and *Uromyces Andropogonis*, which differ from each other only in the number of cells of the teleutospore.

During 1913 no very extensive series of cultures has been reported, but small additions to our knowledge of the biological relations of hitherto isolated forms come from many sources and include studies in several genera. In this

⁷ LONG, W. H., Notes on three species of rusts on *Andropogon*. *Phytopathology* 2:164-171. 1912.

connection the past work of FRASER⁸ on the fern rusts has been of special interest. This author now reports⁹ a further series of cultures supplementing and confirming former work which was not regarded by him as entirely conclusive. The work was done at Pictou, Nova Scotia. Successful infections on *Abies balsamea* (L.) Mill. were made with teleutospores of *Uredinopsis Struthiopteridis* Störmer from *Onoclea Struthiopteris* (L.) Hoff., *U. Osmundae* Magn. from *Osmunda Claytoniana* L., *U. Phegopteridis* Arthur from *Phegopteris Dryopteris* (L.) Fée, and *U. mirabilis* Magn. from *Onoclea sensibilis* L. The aecidial form on *Abies* is *Peridermium balsameum* Peck. Successful infections with aecidiospores of this form were made on *Onoclea Struthiopteris*, *O. sensibilis*, and *Aspidium Thelypteris* Sw. The telial phase on the last is known as *Uredinopsis Atkinsonii* Magn.

Cultures with three other species not belonging to the fern rusts are reported also in confirmation of former work. Teleutospores of *Pucciniastrum Myrtilli* (Schum.) Arthur from *Vaccinium canadense* Kalm produced a *Peridermium* of the type of *P. Peckii* Thüm. on *Tsuga canadensis* (L.) Carr. Teleutospores of *Melampsora Medusae* Thüm. from *Populus grandidentata* Michx. produced *Caeoma Abietis-canadensis* Farl. on *Tsuga canadensis* (L.) Carr. Teleutospores of *Melampsora arctica* Rostr. from *Salix* sp. produced aecidia (*Caeoma* sp.) on *Abies balsamea* (L.) Mill.

Further work on the *Peridermium* rusts is reported by MEINECKE, SPAULDING, and by HEDGCOCK and LONG.

MEINECKE¹⁰ infected *Castilleja miniata* Dougl. with aecidiospores of *Peridermium stalactiforme* Arthur and Kern from *Pinus contorta* Loud. The resulting telial stage is *Cronartium coleosporioides* (Dietel and Holway) Arthur.

HEDGCOCK and LONG¹¹ report the following results. Aecidiospores of *Peridermium inconspicuum* Long from *Pinus virginiana* Mill. produced uredinia (*Coleosporium inconspicuum* (Long) H. and L.) on *Coreopsis verticillata* L.; aecidiospores of *P. delicatulum* Arthur and Kern from *Pinus rigida* Mill. produced uredinia (*Coleosporium delicatulum* (Arthur and Kern) H. and L.) on *Solidago lanceolata* L.; and aecidiospores of *P. stalactiforme* Arthur and Kern from *Pinus contorta* Loud. produced uredinia and telia on *Castilleja linearis* Rydb. The last result is regarded as confirming the work of MEINECKE mentioned above. For the synonymy of these forms see the work of ARTHUR and KERN mentioned below.

In 1907 CLINTON showed that *Peridermium pyriforme* Peck (ex ARTHUR and KERN) on *Pinus silvestris* L. is the aecidial form of *Cronartium Comptoniae*

⁸ Rev. Bot. Gaz. 56:234. 1913.

⁹ FRASER, W. P., Further cultures with heteroecious rusts. Mycologia 5:233-239. 1913.

¹⁰ MEINECKE, E. P., Notes on *Cronartium coleosporioides* Arthur and *Cronartium filamentosum*. Phytopathology 3:167-168. 1913.

¹¹ HEDGCOCK, G. C., and LONG, W. H., Notes on cultures of three species of *Peridermium*. Phytopathology 3:251-252. 1913.

Arthur on *Comptonia asplenifolia* Banks. SPAULDING¹² has now succeeded in infecting this host with aecidiospores of *Peridermium pyriforme* from *Pinus silvestris* (confirming CLINTON'S work), *P. ponderosa* Dougl., *P. Taeda* L., and *P. austriaca* Link. On account of its increasing frequency in nurseries, this fungus is becoming economically important.

JACOB¹³ in a short note reports that teleutospores of *Puccinia Polygoni-amphibii* Pers. from *Polygonum amphibium* L. infected *Geranium pratense* L. (confirming the result of KLEBAHN), *G. pusillum* Burm., and *G. pyrenaicum* Burm. Among the species not infected was *Geranium phaeum* L., which KLEBAHN had successfully infected with this rust. The aecidiospores from these cultures were sown on various species of *Polygonum*, but only *P. amphibium* was infected. Teleutospores of *Puccinia Polygoni* Alb. and Schw. from *Polygonum Convolvulus* L. infected only *Geranium columbinum* L., with a doubtful infection on *G. molle* L. which was successfully infected by KLEBAHN. Aecidiospores from *G. molle* reinfected only *Polygonum Convolvulus*. Uredospores from *Uromyces Kabatianus* Bubák from *G. pyrenaicum* infected *G. pyrenaicum*, *G. maculatum* L., and *G. pusillum* Burm., but not *G. silvaticum* L. which is the principal host of *Uromyces Geranii*. These cultures furnish further evidence in justification of BUBÁK'S separation of *U. Kabatianus* from *U. Geranii*. CRUCHET¹⁴ reports that teleutospores from *Polygonum Bistorta* L. infected *Peucedanum Ostruthium* Koch, and that the aecidiospores (*Aec. Imperatoriae* Cruchet) derived from the culture reinfected *Polygonum Bistorta*. The rust is described as *Puccinia Imperatoriae-mamillata*. CRUCHET was led to suspect this connection by the fact that *Peucedanum Ostruthium* bears, in addition to *Aecidium Imperatoriae*, a micropuccinia whose teleutospores resemble those of *Puccinia mamillata* Schröter on *Polygonum*.

FISCHER¹⁵ in two short papers reports further experiments with *Uromyces caryophyllinus* (Schrank) Winter and *Puccinia Pulsatillae* Kalchb. which is a micropuccinia of the type of *P. Anemonis-virginianae* Schwein. inhabiting members of the Ranunculaceae. In his former work¹⁶ FISCHER found that aecidio-

¹² SPAULDING, P., Notes on *Cronartium Comptoniae*. *Phytopathology* 3:62, 308-310. 1913.

¹³ JACOB, G., Zur Biologie *Geranium*-bewohnender Uredineen. *Mycol. Centralbl.* 3:158-159. 1913.

¹⁴ CRUCHET, P., Contribution à l'étude des Urédinées. Étude biologique et description de *Puccinia Imperatoriae-mamillata*, nov. sp. *Mycol. Centralbl.* 3:209-214. 1913.

¹⁵ FISCHER, ED., Beiträge zur Biologie der Uredineen. 4. Weitere Versuche über die Specialisation des *Uromyces caryophyllinus* (Schrank) Winter. *Mycol. Centralbl.* 3:145-149. 1913.

———, *idem.* 5. *Puccinia Pulsatillae* Kalchb. (Syn. *P. de Baryana* Thüm.) und Theoretisches über die Specialisation. *Ibid.* 214-220. 1913.

¹⁶ *Rev. Bot. Gaz.* 56:237. 1913.

spores of *Uromyces caryophyllinus* from *Euphorbia Gerardiana* Jacq. collected near Heidelberg infected *Tunica prolifera* (L.) Scop. and rarely *Saponaria ocymoides* L., while aecidiospores from the same host collected in the Wallis, Switzerland, infected *Saponaria ocymoides*. The relations of the last form to *Tunica prolifera* were not determined. Further cultures have now shown that the form from the Wallis infects both *Saponaria ocymoides* and *Tunica prolifera* and to some extent also *T. Saxifraga* (L.) Scop. Uredospores from *Saponaria ocymoides* or from *Tunica prolifera* infect either of those hosts indifferently.

The cultures with *Puccinia Pulsatillae* Kalchb. from *Anemone montana* Hoppe showed that this form infects, besides *A. montana*, *A. vernalis* L., *A. pratensis* L., and *A. Pulsatilla* L., but not *A. alpine* L., *A. sylvestris* L., and *Atragene alpina* L. Comparing the specialization of these forms with that of *Uromyces caryophyllinus*, FISCHER distinguishes two types. The first is correlated with the geographical distribution of the hosts and is illustrated by *Uromyces caryophyllinus*. In the Wallis, where both *Saponaria* and *Tunica* are common, this rust occurs on both of these plants, whereas in Baden, where *Saponaria ocymoides* does not occur, the fungus has become adapted to *Tunica prolifera* to such an extent that it scarcely infects *Saponaria*. Specialized races of this type show no distinctive morphological characteristics by which they might be separated from each other. The second type of specialization is correlated with the degree of affinity of the host plants. The forms of rusts showing this type of specialization each inhabit groups of closely related species of host plants and do not cross readily from one group to another. The races showing this type of specialization usually have slight morphological differences, besides their biological behavior, by which they can be distinguished.

ITO¹⁷ reports the successful infection of *Pourthiaea villosa* Decne. with teleutospores of *Gymnosporangium Photiniae* (P. Henn.) Kern (*G. japonicum* Syd.) from stems of *Juniperus chinensis* L. *Pyrus sinensis* Lindl., *P. Malus* L., and *Amelanchier asiatica* Koch were not infected. These cultures show that the stem-inhabiting form of *Gymnosporangium* on *Juniperus chinensis* is connected with *Roestelia Photiniae* P. Henn. and is distinct from the leaf-inhabiting form which the author identifies with *Gymnosporangium Haraeanum* Syd. (*G. asiaticum* Miyabe) which, according to the experiments of SHIRAI and those of HARA cited by the author, belongs to *Roestelia koreaensis* P. Henn. on leaves of *Pyrus sinensis*. SHIRAI does not state whether he used the leaf-inhabiting form or the stem-form in his experiments.

The following papers were published in 1914.

FROMME¹⁸ successfully infected *Myrica cerifera* L. with teleutospores of *Gymnosporangium Ellisii* (Berk.) Farlow from *Chamaecyparis thyoides* L. This

¹⁷ ITO, S., Kleine Notizen über parasitische Pilze Japans. Bot. Mag. Tokyo 27:217-223. 1913.

¹⁸ FROMME, F. D., A new gymnosporangial connection. Mycologia 6:226-230. 1914.

result is of special interest since the aecidial host (*Myrica*) belongs to a family far removed from the Pomaceae. The aecidia are of the cupulate type.

TRANZSCHEL¹⁹ reports the results of cultures carried out from 1911 to 1913. During that time the connections of 4 species of *Puccinia* with their aecidia were established for the first time, and confirmatory cultures were made with 12 other species whose aecidia were known. In each case sowings were made on a number of plants besides those infected. Only the new connections are given here. *Puccinia simplex* (Körn) Eriks. and Henn. from *Hordeum vulgare* L. produced aecidia (*Asc. ornithogalum* Bubák) on *Ornithogalum umbellatum* L. and *O. narbonense* L. Aecidiospores from this culture produced uredospores and teleutospores on *Hordeum vulgare*. *Puccinia Hemerocallidis* Thüm. from *Hemerocallis minor* Mill. produced aecidia (*Aec. Patrinae* P. Henn.) on *Patrinia rupestris* Juss. and *P. scabiosifolia* Link. *Puccinia nitidula* Tranzsch. from *Polygonum alpinum* All. produced aecidia on *Heracleum sibiricum* L. *Puccinia Stipae-sibiricae* Tranzsch. from *Stipa sibirica* L. produced aecidia (*Aec. Sedi-Aizoontis* Tranzsch.) on *Sedum Aizoon* L.

KLEBAHN²⁰ reports new hosts for *Cronartium asclepiadeum* (Willd.) Fr. and various species of *Coleosporium*. Aecidiospores of *Cronartium asclepiadeum* (*Peridermium Cornui* Rostr. and Kleb.) were successfully sown on *Vincetoxicum officinale* Moench (the usual host), *V. fuscatum* Reichenb., *V. laxum* Koch, *Tropaeolum minus* L., *T. majus* L., *T. canariensis* Hort. (*T. peregrinum* L.), *T. Lobbianum* Hort., *Impatiens Balsamina* L., and *Pedicularis palustris* L. Uredospores obtained from the cultures on *Vincetoxicum officinale* infected *Impatiens Balsamina* and *Pedicularis palustris*. Aecidiospores of *Peridermium Pini* (Willd.) Kleb. failed to infect *Tropaeolum minus*, *Pedicularis palustris*, *Vincetoxicum officinale* and *Schizanthus Grahmi* Gill. The results of cultures on *Pedicularis* show that the *Cronartium* on that plant belongs to *Peridermium Cornui* Rostr. and Kleb. and not, as SIRO had erroneously supposed, to *P. Pini* Chev. *P. Pini* remains an isolated aecidium. The observation that the Chilean species, *Schizanthus Grahmi* Gill. growing in Brandenburg was infected with a *Coleosporium* led the author to make sowings of a number of European species of *Coleosporium*, with the surprising result that not one but several of the European forms infected *Schizanthus*. At the same time, cultures were made upon another exotic plant, *Tropaeolum minus* L., upon which *Coleosporium* had been observed. *Schizanthus Grahmi* was infected by uredospores of the following forms: *Coleosporium Euphrasiae* (Schum.) Wint. from *Alectrolophus major* Reichenb. and *A. minor* Wimm. and Grab.; *C. Melampyri* (Rahenh.) Kleb. from *Melampyrum pratense* L.; *C. Campanulae* f. *rapunculoides* Kleb. from *Campanula rapunculoides* L.; *C. Campanulae* f.

¹⁹ TRANZSCHEL, W., Culturversuche mit Uredineen in den Jahren 1911-1913. Mycol. Centralbl. 4:70-71. 1914.

²⁰ KLEBAHN, H., Kulturversuche mit Rostpilzen. Zeitschr. Pflanzenkrank 24:1-32. 1914.

rotundifoliae Kleb. from *Campanula rotundifolia* L.; *C. Campanulae* f. *Trachelii* Kleb. from *Campanula patula* L. and *C. Trachelium* L.; *C. Tussilaginis* (Pers.) Kleb. from *Tussilago Farfara* L.; *C. Senecionis* (Pers.) Fr. from *Senecio sylvaticus* L. and *S. vulgaris* L.; and *C. Sonchi* (Pers.) Lév. from *Sonchus arvensis*. *Tropaeolum* was infected with all these forms except *C. Euphrasiae*, *C. Melampyri*, and *C. Sonchi*.

FRASER²¹ gives a short account of cultures confirming work that has been previously reported. The cultures with *Uredinopsis mirabilis* Magn. deserve mention since they show that this form, which in common with a number of other species of *Uredmopsis* has its aecidia on *Abies balsamea* (L.) Mill., produces its uredospores and teleutospores only on *Onoclea sensibilis* L. and does not infect *Osmunda Claytoniana* L., *O. regalis* L., *Aspidium Thelyteris* (L.) Sw., *Asplenium Felix-foemina* (L.) Bernh., and *Phegopteris Dryopteris* (L.) Fée. These experiments show that *Uredinopsis mirabilis* is a distinct species.

In their revision of the North American species of *Peridermium* on pine, ARTHUR and KERN²² mention cultures establishing the connection between *Peridermium cerebrum* Peck. (*P. fusiforme* Arthur and Kern) from *Pinus Taeda* and *Cronartium Quercus* Arthur on *Quercus rubra* L. and *Q. Phellos* L. This species of *Peridermium* occurs also on many other species of pine.

As a result of cultural experiments with *Gymnosporangium Blasdaleanum* (Dietel and Holway) Kern. (*G. Libocedri* (P. Henn) Kern.) and *Libocedrus decurrens* Torr., JACKSON²³ is able to add *Cydonia vulgaris* L., *Pyrus communis* L., *P. rivularis* Dougl., *Amelanchier alnifolia* Nutt., and *Crataegus* Lindl. to the list of hosts upon which the aecidial generation of this fungus has been grown. The aecidium, which has distinctive characteristics, has been found occurring also in nature upon a number of other plants.

In continuation of his work on the rusts of Southeastern Russia, TREBOUX²⁴ reports the following connections. Aecidiospores from *Ranunculus flammula* L. produced uredospores and teleutospores (*Uromyces Festucae* Syd.) on *Festuca rubra* L. With teleutospores of *Puccinia Magnusiana* Körn. from *Phragmites communis* Trin., which is known to have its aecidia on *Ranunculus repens* L., *R. chaerophyllos* L., *R. creticus* L., *R. illyricus* L., *R. Kotschyi* Boiss. and *R. sardous* Crantz were also infected. The successful infection of *Berberis vulgaris* L. with teleutospores of a *Puccinia* on *Sesleria caerulea* Ard. shows that this rust, which had been described by FISCHER as *P. Sesleriae-caeruleae*, is

²¹ FRASER, W. P., Notes on *Uredinopsis mirabilis* and other rusts. *Mycologia* 6:25-28. 1914.

²² ARTHUR, J. C., and KERN, F. D., North American species of *Peridermium* on pine. *Mycologia* 6:109-138. 1914.

²³ JACKSON, H. S., A new pomaceous rust of economic importance, *Gymnosporangium Blasdaleanum*. *Phytopathology* 4:261-270. pls. 2. 1914.

²⁴ TREBOUX, O., Infectionsversuchen mit parasitischen Pilzen IV. *Ann. Mycol.* 12:480-483. 1914.

P. graminis. Sowings of teleutospores of *Puccinia Phragmitis* (Schum.) Körn. showed that *Rumex aquaticus* L., *R. confertus* Willd., *R. maritimus* L., *R. patientia* L., *R. arifolius* All., *R. bucephalophorus* L., *R. fennicus* Murb., *R. thyrsiflorus* Fingerh., *Rheum palmatum* L., *R. undulatum* L., *R. compactum* L., and *R. tartaricum* L. are additional aecidial hosts for this rust. Further experiments with the crown rusts lead the author to doubt the validity of the species *Puccinia coronifera* which KLEBAHN separated from *P. coronata* (Corda) Kleb. This doubt is founded on the one hand on the infection of a number of typical *P. coronata* hosts with aecidiospores from *Rhamnus cathartica* L., and on the other hand on the infection of *Avena sativa* L., a *P. coronifera* host, by aecidiospores from *R. Frangula* L., the aecidial host for *P. coronata*.—H. HASSELBRING.

Origin of herbaceous angiosperms.—The question of the relative antiquity of herbaceous and woody angiosperms has been considered at some length by SINNOTT and BAILEY.²⁵ It has frequently been assumed, although definite statements of the view are rare, that herbaceous plants preceded the woody, and such a view was likely to be held as long as the monocotyledons were believed to be the older angiosperms. The authors deal with evidence from four sources: paleobotany, anatomy, phylogeny, and phytogeography, and reach a conclusion entirely at variance with the prevailing theory. Under the first head it is pointed out that the ancient club mosses and horsetails were arborescent, but it is admitted that the evidence is not conclusive. The anatomical evidence hinges on the question whether the primary wood was originally a continuous layer or a series of bundles. Examination of various groups of plants leads to the inference that the cambium was originally a complete ring, and that its segregation into "fascicular" and "interfascicular" cambium is a relatively recent occurrence. In explaining how this may have come about, JEFFREY attaches importance to the leaf traces, but from this view our authors dissent; they attribute the production of discrete bundles to a simple decrease in activity of the cambium. In connection with phylogeny, a survey of the families of angiosperms shows that the primitive types are much more woody than the recent ones. In more than half of the families of dicotyledons there are no herbaceous species, and exclusively herbaceous families consist of insectivores, parasites, or other recent forms. Under the heading of phytogeography a large array of facts is gathered, leading to the conclusion that angiosperms made their appearance in the tropics as woody plants, and spread into the north temperate zone, where gradual stunting occurred, largely as a consequence of lowered temperature, resulting finally in the production of annuals. Such herbaceous plants have subsequently spread to all parts of the earth's surface. Insular and other endemic flora

²⁵ SINNOTT, E. W., and BAILEY, I. W., Investigations on the phylogeny of the angiosperms 4. The origin and dispersal of herbaceous angiosperms. Ann. Botany 28:547-600. pls. 39, 40. 1914.